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Elemental profile of tail hair by neutron activation analysis for beef genetic authentication

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The growth in demand for quality beef has stimulated the production of animals with superior genetics. Genetic breedings gave rise to cuts of meat with high added value. Cattle breed certification programs have been created in Brazil to assist in the transparency of the production chain and attest to specific quality attributes of certain breeds. However, this mechanism is not enough to prevent fraud that brings economic losses to producers and consumers. Different analytical techniques have been used to discriminate genetic breeds through the intrinsic characteristics of animals to guarantee genetic origin. For this study, neutron activation analysis was used to assess whether the chemical profile of bovine tail hairs allows for the genetic authentication of animals. Tail hairs were collected from 20 high performance animals from Angus and Wagyu breeds, raised in a certified Brazilian farm that operates in a vertical production system, being responsible for the processes of insemination, breeding, rearing, fattening, slaughtering and marketing of the final product, facilitating the traceability of the production chain. Samples were cleaned with deionized water and analytical standard acetone and cut into small pieces with titanium blade scissors. Analytical portions of approximately 100 mg were placed into high purity polyethylene capsules and irradiated in a thermal neutron flux of $10^{13} \text{ cm}^{-2} \text{ s}^{-1}$ at the nuclear research reactor of IPEN/CNEN. Measurement of induced radioactivity was performed by high resolution gamma ray spectrometry. NIST SRM8414 Bovine Muscle and NIST SRM1577c Bovine Liver certified reference materials were used for analytical quality control. The mass fractions of Br, Ca, Co, Fe, K, La, Na, Rb, Sc, Se and Zn were measured in tail hair samples. Statistically significant interactions ($p < 0.05$) were found between gender and genetic breed for the elements Ca, Co, Fe, Na, Rb, Sc and Se. Machine learning algorithms (Multilayer Perceptron, Naïve Bayes, Random Forest, Random Tree and Support Vector Machine) were used to classify Angus male, Angus female, Wagyu male and Wagyu female. Statistically significant differences ($p < 0.05$) were found between these four categories. It was possible to discriminate categories with 88% accuracy, achieving best classification performance for the Random Forest algorithm. The results indicate that the elemental profile of bovine tail hair can be a potential tool for genetic authentication of animals.

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